Appendix B
Water Conservation Analysis

For the purposes of the WIRP, water conservation was split into passive and active; where passive conservation is defined as what will occur because of California's plumbing code, and active conservation represents programs and ordinances that PWP will implement.

Estimates of passive conservation have been incorporated into the water demand forecast (see Appendix A). Estimates of active conservation were evaluated under different assumptions regarding water saving fixtures, landscaping, new policies and implementation rates. These assumptions are detailed in this appendix.

B.1 Single-Family Landscaping

One of the biggest potential for future active conservation for PWP is reducing water demand for irrigation. California's newly created 'Model Landscape Ordinance' represents a new statewide standard for irrigation of urban landscapes. In its simplest form, it represents a combination of warm season plants (and associated evapotranspiration requirements) and irrigation system efficiency to determine supplemental water needs.

The formula for estimating supplemental water needs for urban landscapes is:

$$LW = (Eto - Eppt) \times (0.62) \times (A) \times (ETAF)$$

Where:

LW = Estimated total supplemental landscape water required
ETo = Reference evapotranspiration from Model Landscape Ordinance
Eppt = Effective natural precipitation available to plants for growth (assumes 25% of monthly precipitation per Model Landscape Ordinance)
0.62 = Conversion factor to gallons
A = Landscape Area
ETAF = Evapotranspiration adjustment factor, which equals landscape coefficient divided by irrigation efficiency

This formula requires several assumptions to be made in order to estimate what the current supplemental water needs are for an average single family home—namely how much tree canopy exists, the current mix of plant materials and the current irrigation efficiency. For PWP's service area it was assumed that:

- Tree canopy is 10 percent of all single-family landscaping
- The current mix of plant materials is 1/3 high water using plants, 1/3 moderate water using plants, and 1/3 low water using plants

- The current irrigation efficiency is 63 percent, meaning there is 37 percent over-application of water

Average precipitation and reference ETo are shown in Table B-1.

Table B-1
Average Precipitation and Reference ETo for Pasadena

	Precipitation[1] (inches)	Effective Precipitation[2] (inches)	Reference ETo[3] (inches)
Jan	6.83	1.71	2.10
Feb	6.38	1.60	2.70
Mar	1.39	0.35	3.70
Apr	1.40	0.35	4.70
May	0.36	0.09	5.10
Jun	0.01	0.00	6.00
Jul	0.01	0.00	7.10
Aug	0.01	0.00	6.70
Sep	0.39	0.10	5.60
Oct	2.04	0.51	4.20
Nov	1.25	0.31	2.60
Dec	3.57	0.89	2.00

1. Rainfall data from Pasadena weather station ID# 6719, 2004 to 2008
2. Represents 25% of actual rainfall (per Model Landscape Ordinance)
3. ETo data from Model Water Efficient Landscape Ordinance, Appendix A

It was assumed that the ETAF (a combination of plant materials and irrigation efficiency) for current resident is 0.96. For a resident that was in compliance with the Model Landscape Ordinance an ETAF of 0.70 was assumed (the smaller the number the more outdoor water conservation is achieved). For an ultra conserving home, one that only has drought-tolerant landscaping (such as succulents and native Southern California plants), an ETAF of 0.07 was used.

Based on data from statewide and regional sources, the cost of converting a non-conserving (or typical) household landscape to comply with the Model Landscape Ordinance is approximately $30 per 100 sq. feet; while the cost to replace conventional landscaping to entirely drought-tolerant landscaping is approximately $150 per sq. feet. If new homes are built with these landscaping requirements from the start, the costs are reduced to zero additional costs for the Model Landscape Ordinance and $100 per sq. feet for drought-tolerant landscaping.

Based on data collected for a recent water budget rate study conducted by PWP, the average single-family landscape area is 3,350 square feet.

Table B-2 uses the above-stated assumptions and equations in order to estimate the irrigation water demands and conservation costs for different types of landscapes for PWP's service area.

Table B-2
Single-Family Household Irrigation Water Demands and Costs for PWP's Service Area

Type of Landscape	Water Needs (Gal/Day)	Water Saved from Base (Gal/Day)	Conservation Cost from Base ($)
Conventional Landscape (Base)	233	-	-
Model Landscape Ordinance	171	62 (27%)	$1,005 (retrofit) $0 (new)
Entirely Drought-Tolerant Landscape	17	216 (93%)	$5,027 (retrofit) 3,351 (new)
Drought-Tolerant Front Yard, Warm Season Grass Backyard	117	116 (50%)	$2,413 (retrofit) $1,173 (new)

If all existing homes in PWP's service area were converted to the Model Landscape Ordinance there would be a conservation savings of 1,630 AFY by 2035, at an annual cost of $904,000 (in today's dollars). If new homes had drought-tolerant front yards and warm season grass backyards, there would be a conservation savings of 540 AFY by 2035, at an annual cost of $194,000.

B.2 Other Landscaping

Using the percent conservation savings and unit costs derived from Table B-2 for the Model Landscape Ordinance for multifamily and commercial landscaping gives us an estimate of the potential for other landscape conservation for PWP. If all existing and new landscaping for multifamily and commercial customers was compliant with the Model Landscape Ordinance then there would be an estimated 1,593 AFY conservation savings by 2035, at an annual cost of $1,159,000.

B.3 Extension/Acceleration of PWP's Current Conservation Programs

PWP currently receives incentives from MWD to implement a variety of water conservation programs such as plumbing fixture retrofits, high efficiency washing machine retrofits, water audits, and commercial/industrial conservation. These programs are currently saving about 3,000 AFY. If these programs were extended through 2035 at accelerated rates (doubling in some cases), these conservation programs would save about 5,200 AFY, at a cost of approximately $1,900,000 per year.

B.4 Multifamily Meters

Several cities in the U.S. are requiring that individual meters be installed for all new multifamily homes (even high rises). Studies from Portland, OR and Australia show that water usage is about 15 to 30 percent lower for multifamily homes that are individually metered vs. master metered. If all new multifamily homes in PWP's service area were individually metered, the estimated conservation savings would be 239 AFY by 2035, at an estimated annual cost of $130,000.

B.5 Water Conservation Scenarios

For the WIRP, three water conservation scenarios were created to determine potential water savings and annual costs. It should be noted that the costs presented in this appendix represent the total cost of implementing conservation and not necessarily what PWP would have to spend. In fact, through ordinances, PWP's cost would be significantly lower but the cost would then shift to customers and developers. The three conservation scenarios are:

- Moderate Conservation – Essentially a continuation of PWP's current conservation program throughout the planning period, but with some new outdoor water conservation.

- Aggressive Conservation – Greater emphasis on outdoor conservation and significantly increasing PWP's current indoor conservation programs, including individual water meters for all new multifamily homes.

- Maximum Conservation – Requiring most homes to have drought-tolerant landscaping along with very aggressive indoor conservation with ordinances requiring plumbing retrofits on resale of properties and ordinances for existing landscaping conversions.

Table B-3 presents the total annual water conservation savings and estimated total costs for these three scenarios.

Table B-3
Water Conservation Scenarios for WIRP

	Conservation Savings (Acre-Feet/Year)			Total Annual Conservation Costs ($)		
	Moderate	Aggressive	Maximum	Moderate	Aggressive	Maximum
2010	358	612	806	$2,950,029	$7,779,029	$10,865,525
2011	716	1,255	1,658	$2,950,029	$8,103,933	$11,195,929
2012	1,074	1,897	2,510	$2,950,029	$8,103,933	$11,195,929
2013	1,432	2,509	3,314	$2,950,029	$7,333,933	$10,420,429
2014	1,790	3,121	4,119	$2,950,029	$7,333,933	$10,420,429
2015	2,148	3,733	4,924	$2,950,029	$7,333,933	$10,420,429
2016	2,507	4,283	5,635	$2,950,029	$5,793,933	$8,110,429
2017	2,865	4,771	6,269	$2,950,029	$4,253,933	$6,185,429
2018	3,223	5,258	6,903	$2,950,029	$4,253,933	$6,185,429
2019	3,533	5,562	7,353	$2,933,529	$2,999,933	$4,931,429
2020	3,843	5,866	7,783	$2,933,529	$2,999,933	$4,837,929
2021	4,072	6,089	8,078	$2,933,529	$2,999,933	$4,353,929
2022	4,301	6,312	8,374	$2,933,529	$2,999,933	$4,353,929
2023	4,530	6,535	8,669	$2,933,529	$2,999,933	$4,353,929
2024	4,759	6,757	8,965	$2,933,529	$2,999,933	$4,353,929
2025	4,930	6,980	9,261	$2,581,529	$2,999,933	$4,353,929
2026	5,100	7,182	9,535	$2,581,529	$2,906,433	$4,260,429
2027	5,271	7,384	9,810	$2,581,529	$2,906,433	$4,260,429
2028	5,442	7,586	10,084	$2,581,529	$2,906,433	$4,260,429
2029	5,612	7,788	10,359	$2,581,529	$2,906,433	$4,260,429
2030	5,783	7,989	10,634	$2,581,529	$2,906,433	$4,260,429
2031	5,954	8,191	10,908	$2,581,529	$2,906,433	$4,260,429
2032	6,125	8,393	11,183	$2,581,529	$2,906,433	$4,260,429
2033	6,295	8,595	11,458	$2,581,529	$2,906,433	$4,260,429
2034	6,466	8,797	11,732	$2,581,529	$2,906,433	$4,260,429
2035	6,637	8,999	12,007	$2,581,529	$2,906,433	$4,260,429
Unit Cost ($/AF)	NA	NA	NA	$692	$724	$787

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